CORPORATE FORECASTING

AN EDMONTON HOUSING MARKET MODEL

Research Paper No. 10

THE CITY OF Edmonton PLANNING AND BUILDING

Research Paper No. 10

AN EDMONTON HOUSING MARKET MODEL

by
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IMPORTANT NOTE

This Technical Paper has been prepared by the Corporate Forecasting Group, Long Range Planning Branch, Planning and Building Department. The Paper documents research results as part of an ongoing forecasting activity. Neither the methods nor the results have been endorsed by the City of Edmonton.

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TABLE OF CONTENTS

		PAGE
Acknowledgements		
1.	Introduction	1
2.	Single Family Housing Model	2
	A) Single Family Housing Starts	2
	B) Single Family Housing Completions	4
	C) Single Family Housing Absorptions	5
	D) Single Family Housing Inventory	6
3.	Total Housing Model	7
	A) Total Housing Starts	7
	B) Total Housing Completions	8
	C) Total Housing Absorptions	8
4.	Multiple Family Housing Model	9
	A) Multiple Family Housing Starts	10
	B) Multiple Family Housing Completions	10
	C) Multiple Family Housing Absorptions	10
	D) Apartment Vacancy Rates	11
5.	Housing Forecasts	12
6.	Conclusions	13
Bibliography		16
Appendix: Historical Data, 1972-1985		17

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AN EDMONTON HOUSING MARKET MODEL

A previous paper, A Housing Starts Forecasting Model for Edmonton (Huang and Higgins, February, 1986) outlined an econometric model to forecast housing starts. This paper refines and expands the earlier model by increasing the statistical reliability of the starts equation and by providing forecasts for completions, absorptions and the apartment vacancy rate.

1. INTRODUCTION

Residential construction is an important component of the Edmonton economy, requiring large amounts of land and costly infrastructure. Reliable forecasts of housing starts are a prerequisite for timely and efficient planning. Planning and Building Department's forecasts of residential construction starts have been based primarily on demographic methods which concentrated on estimating increases in the numbers of households. This method provided only a general indication of the amount of new dwellings that would be required because new households may occupy existing rental housing rather than purchase new housing.

A model which produces forecasts of housing starts, completions and absorptions based on economic and demographic factors would considerably improve housing forecasts for the City of Edmonton. The purposes of this report are:

1) to identify the economic and demographic factors influencing residential construction through development of a residential housing market model; and

2) to utilize the model to forecast residential construction in Edmonton for use in the preparation of the annual Housing Market Report and the annual Socio-Economic Forecast Report. In addition, the model will be integrated with other models into a large scale econometric model of the Edmonton economy.

The model consists of three components: single family housing, multiple family housing and total housing. Each component contains equations for housing starts, completions and absorptions. In addition, the multiple family housing component contains an equation for apartment vacancy rates. The flow chart in Figure 1 shows the relationships between the three components and the variables within each component.

Single family housing is discussed and estimated in Section 2, total family housing in Section 3 and multiple family housing in Section 4. Forecasts based on the estimated model are presented in Section 5 and conclusions are given in Section 6.

The time period covered for estimating and testing the model extends from 1972 to 1985. Appendix A lists the data used. The model was estimated and tested using the ordinary least squares method and the Cochrane-Orcutt iteration method if serial auto-correlations are present.

2. SINGLE FAMILY HOUSING MODEL

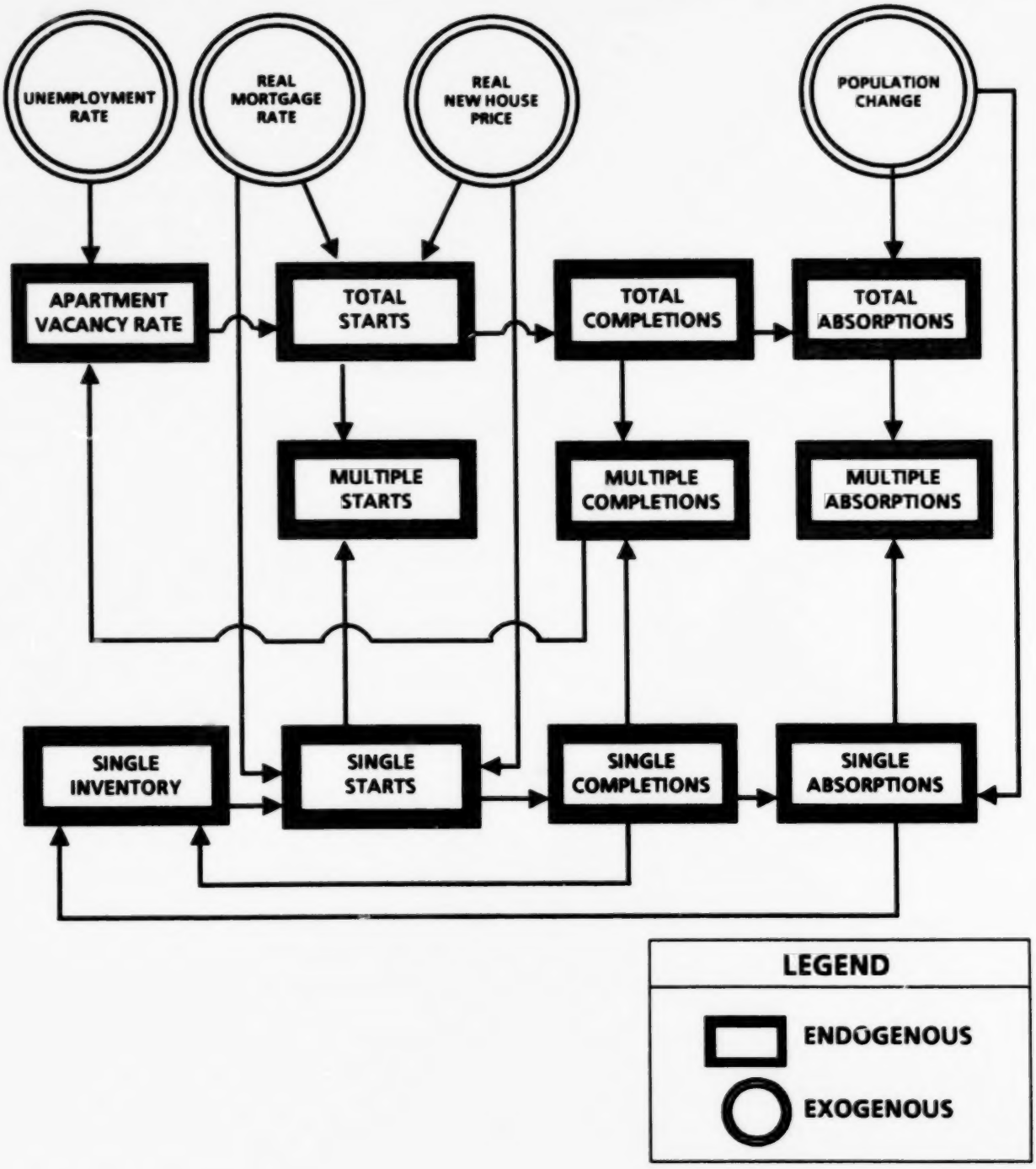
The single family housing model consists of three categories: starts, completions and absorption. Each component is represented by an equation.

A) Single Family Housing Starts

As discussed in a previous paper A Housing Starts Forecasting Model for Edmonton, (Huang and Higgins, February 1986), starts are influenced by three main factors: real mortgage rates, real new house prices and the inventory of new houses. Higher real mortgage rates are expected to lower the number of housing starts by reducing effective demand and supply because of higher costs to consumers and producers. Conversely, lower real mortgage rates are expected to stimulate starts by increasing effective demand.

FIGURE 1

EDMONTON HOUSING MODEL
FLOW CHART



Rising real new house prices are expected to stimulate starts for several reasons. Firstly, on the demand side, rising real prices enhance housing's attractiveness as an investment. Rising prices also prompt demand for housing because of the higher cost to the consumer implied by delaying the purchase of housing. This reflects the inflation expectation effect on housing demand. Rising house prices also give greater profit to the builder, thus stimulating the supply side. It is expected that a high inventory of newly completed single family houses will depress starts because of the associated high carrying costs.

The results of statistically estimating and testing the above relationships are shown below:

$$SS = 1019 - 226.738\ RMRL1 + 28.2166\ RNHL2 - .673408\ SINVL1$$
$$\quad (.76) \quad (-6.43) \qquad\qquad (6.09) \qquad\qquad (-3.01)$$

$R^2 = .86 \quad R^{-2} = .82 \quad SEE = 467 \quad DW = 2.77 \quad Rho = -.74$

Where:

SS = The number of single family housing starts in the current year

RMRL1 = The five year mortgage rate adjusted for inflation, lagged one year, in percent

RNHL2 = The index value of the price of new single family housing lagged two years, deflated by the consumer price index

SINVL1 = The inventory of newly completed and unoccupied single family houses lagged one year

R^2 = Coefficient of multiple determination

R^{-2} = Coefficient of multiple determination corrected for degree of freedom

SEE = Standard error of estimates

DW = Durbin-Watson statistic

Rho = Coefficient of serial autocorrelation

Figures in parentheses are Student's "t" statistics. The "t" test indicates that all the explanatory variables are statistically significant at the 99% level of confidence.

The equation indicates that a 1% drop in the real mortgage rate resulted in an increase of 226 starts, while a 1 point increase in the real new housing price index brought about a rise of 28 starts. For every decrease of 100 units in the inventory of single family houses, 67 more starts will occur.

The three variables together explain 86% of the total variation of single family housing starts in Edmonton between 1972 and 1985. The above relationships indicate that the real mortgage rate is the most significant factor influencing single family housing starts.

B) Single Family Housing Completions

Completions of single family houses are determined mainly by housing starts in the current year and in the previous year. Housing starts are the major factor influencing completions because the cost of starting a single family house is high and the building must be finished before the builder's investment can be recouped.

The results of statistically estimating and testing the above relationship are shown below:

$$SCOMP = -160 + 0.52455\ SS + 0.624\ SSL1$$
$$(-1.86)\ (4.57)\qquad (5.45)$$

$R^2 = .86$ $R^{-2} = .83$ SEE = 412.7 DW = 2.62 Rho = -.61

Where:

SCOMP = The number of single family houses completed in the current year

SS = The number of single family housing starts in the current year

SSL1 = The number of single family housing starts in the previous year

The Student's "t" test indicates that all the explanatory variables are statistically significant at the 99.5% level of confidence. The two explanatory variables account for 86% of the total variation of single family housing completions between 1972 and 1985.

This equation indicates that about a half of single houses started in a year are completed during the same year and another half are completed during the following year.

C) Single Family Housing Absorptions

Absorption refers to the occupation of a newly-completed dwelling unit. The model hypothesizes that single family housing completions and annual population change are the main determinants of single family housing absorptions. A higher level of completions increases the supply of houses, thus providing more choice for potential buyers and raising demand during an economic boom time. During a recession period, houses are built only to order to eliminate the expense of carrying a costly inventory of newly-completed dwellings. Thus, nearly all single family housing completions are absorbed (a few newly-completed houses are held as show homes). Large population increases strengthen the demand for housing and push up housing absorptions.

The tested equation is shown below:

$$SABS = 270 + 0.768\ SCOMP + 0.03054\ POP$$
$$(2.17)\ (11.85) \qquad (2.09)$$

$R^2 = .94 \quad R^{-2} = .93 \quad SEE = 255 \quad DW = 1.70$

Where:

SABS = The number of single family houses absorbed in the current year

SCOMP = The number of single family houses completed in the current year

POP = The annual change in population

The Student's "t" test indicates that all the explanatory variables are statistically significant at the 95% level of confidence. The two explanatory variables account for 94% of the total variation of single family housing absorptions between 1972 and 1985.

The estimated equation shows that approximately 77% of the newly-completed houses were absorbed in the same year during the period 1972-1985. For a 1,000 population increase, there were 30 new houses absorbed in the year.

D) Single Family Housing Inventory

By definition, inventory for the current year is equal to inventory for the previous year plus new housing completions minus housing absorptions for the year, that is:

SINV = SINVLI + SCOMP - SABS

Where:

SINV = The single family housing inventory for the current year.

SINVL1 = The single family housing inventory for the previous year.

SCOMP = The number of single family houses completed in the current year.

SABS = The number of single family houses absorbed in the current year.

3. TOTAL HOUSING MODEL

A) Total Housing Starts

As with single housing starts, real mortgage rates and real new house prices are variables which have a strong influence on the total number of housing starts. These variables influence total starts in the same manner as single starts. The apartment vacancy rate affects total housing starts as well. High vacancy rates discourage investment in apartment housing construction because of the likelihood of low investment returns, whereas low vacancy rates encourage apartment starts. The tested equation is shown below:

$$TS = 1465 - 418.18947\ RMR - 397.282\ VRL1 + 62.08394\ RNHL2$$
$$(.48)\quad (-1.80)\qquad (-1.38)\qquad (1.80)$$

$R^2 = .83 \quad R^{-2} = .78 \quad SEE = 1706.5 \quad DW = 1.84$

Where:

TS = The total number of housing starts in the current year

RMR = The five year mortgage rate adjusted for inflation, in percent

VRL1 = The apartment vacancy rate lagged one year

RNHL2 = The index value of the price of new single family housing lagged two years, deflated by the consumer price index

The Student's "t" test indicates that all the explanatory variables are statistically significant at the 90% level of confidence. The three explanatory variables account for 83% of the total variation of total housing starts between 1972 and 1985.

The equation indicates that a 1% drop in the real mortgage rate resulted in an increase of 418 starts while a 1% drop in the apartment vacancy rate brought about a rise of 397 starts in the year. Similarly, for a one point increase in the real new housing price index, there was an increase of 62 starts.

B) Total Housing Completions

As with single family housing completions, the main variables determining total housing completions are total starts in the current year and total starts in the previous year. The tested equation is shown below:

$$TCOMP = 160 + .36595\ TS + .65386\ TSL1$$
$$(-.30)\ (3.48) \qquad (5.66)$$

$R^2 = .92 \quad R^{-2} = .91 \quad SEE = 1028 \quad DW = 1.97$

Where:

TCOMP = The total number of housing completions in the current year
TS = The total number of housing starts in the current year
TSL1 = The total number of housing starts lagged one year

The Student's "t" test indicates that the explanatory variables are statistically significant at the 99.5% level of confidence. The two explanatory variables account for 92% of the total variation of all housing completions between 1972 and 1985.

This equation shows that approximately 36% of total dwelling units completed in a year were started in the same year, while the balance were started one year earlier.

C) Total Housing Absorptions

Absorption of total dwelling units is influenced by total completions and the population change of the previous year. These variables act in the same manner as the variables for single family housing absorption. The tested equation is shown below:

$$TABS = 28 + .78682\ TCOMP + .11339\ POPL1$$
$$(2.42)\ (24.45) \qquad (5.43)$$

$R^2 = .98 \quad R^{-2} = .98 \quad SEE = 357 \quad DW = 1.1$

Where:

TABS = The total number of dwelling units absorbed in the current year

TCOMP = The total number of dwelling units completed in the current year

POPL1 = The annual population change lagged one year

The Student's "t" test indicates that the explanatory variables are statistically significant at the 99.5% level of confidence. The two explanatory variables account for 98% of the total variation of all housing absorptions between 1972 and 1985.

This equation shows that approximately 79% of total dwelling units completed in a year are absorbed in the same year. For a 1,000 population increase, there are 113 total housing absorbed in the year.

4. MULTIPLE FAMILY HOUSING MODEL

A structural equation for multiple family starts, completions and absorptions was derived. However, when the estimated equation was used to forecast multiple family housing starts, large negative values were obtained. Therefore, the categories of the multiple family housing model (starts, completions and absorptions) are derived by subtracting the results of the single family housing model from the total housing model. The derived results for starts, completions and absorptions are used for the equation for the vacancy rate which is then used as a variable in the total housing model.

A) Multiple Family Housing Starts

By definition, multiple family housing starts are the difference between total housing starts and single family housing starts, that is,

MS = TS - SS

Where:

MS = Multiple family housing starts
TS = Total housing starts
SS = Single family housing starts

B) Multiple Family Housing Completions

Similarly, multiple family housing completions are the difference between total housing completions and single family housing completions, that is,

MCOMP = TCOMP - SCOMP

Where:

MCOMP = Multiple family housing completions
TCOMP = Total housing completions
SCOMP = Single family housing completions

C) Multiple Family Housing Absorptions

Multiple family housing absorptions is obtained by subtracting single family housing absorptions from total housing absorptions, that is,

MABS = TABS - SABS

Where:

MABS = Multiple family housing absorptions
TABS = Total housing absorptions
SABS = Single family housing absorptions

D) Apartment Vacancy Rates

Apartment vacancy rates are influenced primarily by three variables, the unemployment rate, the number of multiple family completions in the previous year and the vacancy rate in the previous year.

During a period of high unemployment rates, out-migration tends to exceed in-migration, resulting in a loss of population and a decline in housing demand. As a result, apartment vacancy rates go up. During a period of low unemployment rates, a positive net migration brings about an increase in population and a rise in housing demand. Apartment vacancy rates decline, as a result. Furthermore, apartments are occupied primarily by persons in younger age groups whose housing requirements are more flexible than older age groups. High unemployment rates affect the younger age groups particularly heavily, prompting individuals to reduce housing costs by sharing accommodation or postponing leaving home. Conversely, low unemployment rates lower the vacancy rate because a larger number of persons can afford a higher level of housing.

Completions of multiple family housing units (which include apartments), increase vacancy rates by increasing supply of apartment units. The vacancy rate lagged one year is a trend variable. The estimated equation is shown below:

$$VR = -4.5 + .45713\ UR + .00049\ MCL1 + .51634\ VRL1$$
$$(2.92)\ (3.51) \qquad (2.90) \qquad (3.53)$$

$R^2 = .85 \quad R^{-2} = .81 \quad SEE = 1.42 \quad DW = 1.24$

Where:

VR = The apartment vacancy rate of the current year
UR = The unemployment rate of the current year
MCL1 = The number of multiple family units completed in the current year
VRL1 = The apartment vacancy rate lagged one year

The Student's "t" test shows that the explanatory variables are statistically significant at the 99% level of confidence. The three explanatory variables account for 85% of the total variation of the apartment vacancy rate between 1972 and 1985.

The equation indicates that, for a 1% rise in the unemployment rate, there is an increase of nearly 0.46% in the apartment vacancy rate; for every 1,000 unit increase in multiple family housing completions, there is a rise of about 0.5% in the apartment vacancy rate.

5. HOUSING FORECASTS

The housing model discussed above links the housing market in Edmonton with economic variables as well as a demographic variable. Table 1 provides a forecast of these variables along with a forecast of the Edmonton new housing market.

The forecast indicates minimal growth in housing construction over the next five years. This trend is consistent with the forecasts of economic variables such as Alberta's GDP and Edmonton employment growth.

Table 2 provides a comparison between the model's forecast and the forecast prepared by the City of Edmonton's Socio-Economic Forecast Committee (October, 1986). The forecasts for total starts are similar. But the housing model forecasts for multiple family housing starts are higher than the Committee's figures.

6. CONCLUSIONS

A strong relationship has been identified between the housing market and economic variables such as mortgage rates and the real price of new housing. These relationships, represented by the equations shown in Sections 2 and 3, allow forecasts of new housing activity to reflect economic forecasts. This is a considerable improvement over the previous demographically based method of forecasting housing starts. The housing market model will be used in the preparation of next year's annual Housing Market Report and reports of the City of Edmonton Forecast Committee. In addition, the Model will be incorporated in The Econometric Model of the Edmonton Economy.

23-Oct-86

TABLE 1
EDMONTON HOUSING MARKET FORECAST
(City Forecast Committee)

(A) TOTAL

YEAR	REAL* MORTGAGE R (%)	REAL* NEW HOUSE 1971=100	POPULATION* CHANGE	VACANCY RATE (%)	STARTS	COMPLETIONS	ABSORPTION
1984		101.9		10.5			
1985	8.94	92.7	4,769	5.9	1,970	1,891	2,045
1986	8.10	98.8	3,774	4.2	2,060	2,202	2,301
1987	7.44	101.1	7,069	3.5	2,431	2,397	2,342
1988	6.69	102	7,374	3.4	3,428	3,004	3,193
1989	6.42	103.2	7,660	3.8	3,711	3,759	3,822
1990	6.22	104.6	8,236	4.3	3,695	3,938	3,995
1991	5.95	106.7	9,428	4.7	3,670	3,919	4,046

(B) SINGLE

YEAR	REAL* MORTGAGE R (%)	REAL* NEW HOUSE 1971=100	POPULATION* CHANGE	INVENTORY	STARTS	COMPLETIONS	ABSORPTION
1984	10.63	101.9					
1985	8.94	92.7	4,769	53	1,890	1,596	1,638
1986	8.10	98.8	3,774	127	1,832	1,980	1,906
1987	7.44	101.1	7,069	78	1,713	1,881	1,931
1988	6.69	102	7,374	46	2,068	1,993	2,026
1989	6.42	103.2	7,660	87	2,324	2,349	2,308
1990	6.22	104.6	8,236	155	2,383	2,540	2,472
1991	5.95	106.7	9,428	200	2,416	2,595	2,550

(C) MULTIPLE

YEAR	REAL* MORTGAGE R (%)	POPULATION* CHANGE	UNEMPLOYMENT* RATE (%)	VACANCY RATE (%)	STARTS	COMPLETIONS	ABSORPTION
1984	10.63			10.5			
1985	8.94	4,769	12.2	5.9	80	295	407
1986	8.10	3,774	12.1	4.2	228	222	395
1987	7.44	7,069	12.4	3.5	719	515	411
1988	6.69	7,374	12.8	3.4	1,360	1,011	1,168
1989	6.42	7,660	13.2	3.8	1,386	1,410	1,514
1990	6.22	8,236	13.5	4.3	1,312	1,398	1,523
1991	5.95	9,428	13.7	4.7	1,254	1,325	1,495

*Exogenous Variables (Planning and Building Department, October, 1986)

Table 2 Forecasts of Housing Starts

Housing Forecasts

	Total Starts		Single Starts		Multiple Starts		Vacancy Rate	
	Model[1]	Committee[2]	Model	Committee	Model	Committee	Model	Committee
1986	2,060	1,800	1,832	1,800	228	-	4.2	3.5
1987	2,431	2,500	1,713	2,300	719	200	3.5	3.0
1988	3,428	3,000	2,068	2,600	1,360	400	3.4	3.0
1989	3,711	3,200	2,324	2,800	1,386	400	3.8	3.0
1990	3,695	3,600	2,383	3,100	1,312	500	4.3	3.0
1991	3,670	3,900	2,416	3,400	1,254	500	4.7	3.0

Source: 1. Edmonton Housing Market Model

2. City of Edmonton Socio-Economic Forecast Committee (October, 1986)

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APPENDIX

HISTORICAL DATA, 1972 - 1985

HISTORICAL DATA 1972 - 1985

Year	Real Mortgage Rate (1)	Real New House Price (2)	Population Change (3)	Vacancy Rate (4)	Unemployment Rate (2)
1972	4.61	104.5	5,266	7.6	5.1
1973	3.02	117.8	4,296	5.3	4.7
1974	1.38	139.1	3,326	.8	3.1
1975	2.70	149.3	5,944	.3	4.0
1976	3.81	165.6	9,924	.01	4.0
1977	1.33	162.2	9,915	.1	4.2
1978	.48	159.2	6,592	.8	4.7
1979	3.02	157.3	13,293	1.9	3.7
1980	4.24	154.0	14,414	1.1	4.1
1981	5.65	144.4	15,432	1.1	4.1
1982	7.07	127.8	20,809	4.0	8.0
1983	7.40	111.4	8,771	8.5	12.1
1984	10.63	101.9	2,918	10.4	14.1
1985	8.92	92.7	4,769	5.9	12.2

Sources:
1. Bank of Canada Review
2. Statistics Canada
3. City of Edmonton, Planning and Building Department
4. Canada Mortgage and Housing Corporation

HISTORICAL DATA 1972 - 1985 (continued)

Year	Single Starts	Single Completions	Single Absorption	Single Inventory	Multiple Starts
1972	1,651	1,497	1,504	146	5,113
1973	2,313	1,626	1,665	107	2,409
1974	2,355	2,902	2,841	168	1,412
1975	3,996	2,034	2,062	140	2,951
1976	3,723	4,299	4,300	139	6,536
1977	3,207	3,759	3,733	189	7,444
1978	5,434	4,484	4,101	429	9,234
1979	4,138	4,990	4,117	1,302	5,544
1980	3,191	3,586	3,640	1,248	5,255
1981	4,046	4,359	4,305	1,302	6,471
1982	1,812	2,256	2,852	727	7,300
1983	3,003	2,473	3,010	190	2,053
1984	1,750	2,540	2,640	93	127
1985	1,890	1,596	1,638	53	80

Source: Canada Mortgage and Housing Corporation

HISTORICAL DATA 1972 - 1985 (continued)

Year	Multiple Completions	Multiple Absorptions	Total Starts	Total Completions	Total Absorptions
1972	5,987	6,325	6,764	7,484	7,829
1973	5,483	5,712	4,722	7,109	7,377
1974	2,608	2,931	3,767	5,510	5,772
1975	1,470	1,467	6,947	3,504	3,529
1976	2,364	2,365	10,259	6,663	6,665
1977	7,221	6,419	10,651	10,980	10,152
1978	9,090	8,298	14,668	13,574	12,399
1979	7,651	6,769	9,682	12,641	10,886
1980	4,590	5,147	8,446	8,176	8,787
1981	5,282	5,455	10,517	9,641	9,760
1982	7,294	6,947	9,112	9,550	9,799
1983	5,271	6,146	5,056	7,744	9,156
1984	1,198	1,584	1,877	3,738	4,224
1985	295	407	1,970	1,891	2,045

Source: Canada Mortgage and Housing Corporation